Infection control in Burn units

Hans Flaatten
Overview of my talk

• Infection epidemiology in the burn unit
• Bacterial flora
• Sepsis in burn patients
• Antimicrobial therapy
  • Systemic
  • Local
• Infection prophylaxis
Some facts

• Burns are a major public health problem globally, resulting in more than 265,000 deaths and incurring 19 million disability adjusted life years annually.

• In survivors (> first 24 h) the subsequent mortality is caused by infections in 30-75%.
Epidemiology
Burns infection profile of Singapore: prevalence of multidrug-resistant *Acinetobacter baumannii* and the role of blood cultures

Christopher Tam Song\(^1\), Jolie Hwee\(^2\), Colin Song\(^3\), Bien Keem Tan\(^2\) and Si Jack Chong\(^2\)
653 burns patients admitted

201 patients were excluded:
200 patients without cultures
1 patient with insufficient data

452 patients included

272 patients with at least one positive culture

180 patients with negative cultures
Bacteriology
Some particular point to remember

• Bacterial infections are very common
• Occurrence increases with the size of burn area
• There is a vide variety of organism
  • Often 30-40 different species in reported cohorts
• The culture is also context specific
• Increasing problem of multiresistant bacteria
• In particular Acinetobacter Baumani
From Song et al: Burns & Trauma 2016
Risk Factors and Outcome Analysis of Acinetobacter baumannii Complex Bacteremia in Critical Patients*

Hao-Yuan Lee, MD\textsuperscript{1,2,3}; Chyi-Liang Chen, PhD\textsuperscript{2,3}; Si-Ru Wu, BS\textsuperscript{3}; Chih-Wei Huang, BS\textsuperscript{3}; Cheng-Hsun Chiu, MD, PhD\textsuperscript{1,2,3}
Resistance and drug choice

A patient with sepsis following a burn injury in Pakistan

A female patient in her forties was transferred to the Burn Centre at Haukeland University Hospital four weeks after a severe burn injury in Pakistan. During the next two days she developed sepsis and multi-organ failure.

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## Table 1 Bacteriological findings in samples taken after patient's arrival at Haukeland University Hospital

<table>
<thead>
<tr>
<th>Location</th>
<th>Microorganism</th>
<th>Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blood cultures</td>
<td><em>Pseudomonas aeruginosa</em></td>
<td>Wild type isolate</td>
</tr>
<tr>
<td>Removed central venous catheter</td>
<td><em>Klebsiella pneumoniae</em></td>
<td>ESBL&lt;sub&gt;M&lt;/sub&gt; and ESBL&lt;sub&gt;ESBL&lt;/sub&gt;</td>
</tr>
<tr>
<td></td>
<td><em>Proteus mirabilis</em></td>
<td>ESBL&lt;sub&gt;CARBA&lt;/sub&gt;-&lt;sub&gt;B&lt;/sub&gt;</td>
</tr>
<tr>
<td></td>
<td><em>Enterobacter cloacae</em></td>
<td>ESBL&lt;sub&gt;A&lt;/sub&gt;</td>
</tr>
<tr>
<td></td>
<td><em>Providencia stuartii</em></td>
<td>ESBL&lt;sub&gt;M&lt;/sub&gt; and ESBL&lt;sub&gt;CARBA&lt;/sub&gt;-&lt;sub&gt;B&lt;/sub&gt;</td>
</tr>
<tr>
<td></td>
<td><em>Pseudomonas aeruginosa</em></td>
<td>ESBL&lt;sub&gt;CARBA&lt;/sub&gt;-&lt;sub&gt;B&lt;/sub&gt;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>16S rRNA-methylase possible</td>
</tr>
<tr>
<td></td>
<td><em>Acinetobacter baumannii</em></td>
<td>AmpC/efflux/porin loss</td>
</tr>
<tr>
<td></td>
<td><em>Stenotrophomonas maltophilia</em></td>
<td>-</td>
</tr>
<tr>
<td></td>
<td><em>Methicillin-resistant Staphylococcus aureus</em></td>
<td>-</td>
</tr>
<tr>
<td></td>
<td><em>Alkaligenes faecalis</em></td>
<td>-</td>
</tr>
<tr>
<td></td>
<td><em>Bordetella trematurn</em></td>
<td>-</td>
</tr>
</tbody>
</table>
Kvinne døde på Haukeland - reagerte ikke på antibiotikabehandling

HANNE LOUISE ÅKEMES
OPPLAGERT: 30. AUG. 2018 19:54 / PUBLISERT: 30. AUG. 2018 19:54

En kvinne i 40-årene døde 56 timer etter at hun kom til Norge. Kroppen reagerte ikke på antibiotika-behandlingen.
Sepsis in burn patients
New definition of sepsis & septic shock

Clinical Review & Education

Special Communication | CARING FOR THE CRITICALLY ILL PATIENT

The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3)

Mervyn Singer, MD, FRCP; Clifford S. Deutschman, MD, MS; Christopher Warren Seymour, MD, MSc; Manu Shankar-Hari, MSc, MD, FFICM; Djillali Annane, MD, PhD; Michael Bauer, MD; Rinaldo Bellomo, MD; Gordon R. Bernard, MD; Jean-Daniel Chiche, MD, PhD; Craig M. Coopersmith, MD; Richard S. Hotchkiss, MD; Mitchell M. Levy, MD; John C. Marshall, MD; Greg S. Martin, MD, MSc; Steven M. Opal, MD; Gordon D. Rubenfeld, MD, MS; Tom van der Poll, MD, PhD; Jean-Louis Vincent, MD, PhD; Derek C. Angus, MD, MPH
Fundamental understanding of sepsis

• Sepsis is defined as life-threatening **organ dysfunction** caused by a dysregulated host response to infection.

• Sepsis is a syndrome shaped by pathogen factors and host factors (eg, sex, race and other genetic determinants, age, comorbidities, environment) with characteristics that evolve over time.

• What differentiates **sepsis** from **infection** is an aberrant or dysregulated host response and the presence of **organ dysfunction**.
SEPSIS = Infection + New organ dysfunction
Organ dysfunction in sepsis

• Sepsis-induced organ dysfunction may be occult; therefore, its presence should be considered in any patient presenting with infection.

• Conversely, unrecognized infection may be the cause of new-onset organ dysfunction. Any unexplained organ dysfunction should thus raise the possibility of underlying infection.
The new definition and severe burns

• Previously
  • A very high incidence of sepsis in burn patients
  • Nearly all fulfilled the SIRS criteria
  • Most patients at some time during their hospital stay had proven or suspected infections

• The new definition will probably reduce the incidence considerably, since true organ dysfunction occurs less frequently than SIRS

• Now data on this exists yet
Antimicrobial therapy
Clinical infection in burns

• Often difficult to detect, since the inflammatory responses of burns overlap with those of infection:
  • Leucocyte count, CRP, PCT, fever, tachycardia etc
• Most burn centres have routine bacterial surveillance of their patients
• Problem is growth in burn area, initially sterile but will rapidly become contaminated
• Growth in “sterile” areas = strong suspicion of new infection
  • Blood-culture; BAL/PBS; central lines; CSF
• New or increasing organ failure; always suspect new infection/sepsis in a burn patient
Choice of agents

• If resistance pattern for the probable infection is known; easy task

• If no resistance pattern as available, then the clinical condition of the patient often dictate how aggressive (broad) coverage one should give
  • Septic shock > wound infection

• In large burns (> 40% BSA) very suspect Pseudomonas and/or Acinetobacter Baumannii

• “Know the locals”: common pathogens in the ICU and their “usual resistance pattern”. Use that as a guide
Silver sulfadiazine

Review

The role of silver sulphadiazine in the conservative treatment of partial thickness burn wounds: A systematic review

A. Heyneman *, H. Hoeksema, D. Vandekerckhove, A. Pirayesh

Department of Plastic and Reconstructive Surgery, Ghent University Hospital, Ghent, Belgium

Systematic (IUPAC) name

Silver [(4-aminophenyl)sulfonyl](pyrimidin-2-yl)azanide
Results: Infections

• 40 studies had infection as outcome
  • 29 found no difference between SSD and alternative
  • In five studies the comparative dressing was more antibacterial than SSD
  • One found better effect than alternative (jelonet)
  • Five found NS improvement with SSD@

• Conclusion
  • No effect of SSD
Prophylactic measures
Routine systemic antibiotic prophylaxis for burn injuries in developing countries: A best evidence topic (BET)

Barclay T. Stewart a, b, *, Adam Gyedu b, c, Pius Agbenorku b, c, Richcane Amankwa d, Adam L. Kushner e, f, g, Nicole Gibran h, i
Results

- Three prospective randomised trials were found
  - Tunisia, Nigeria and Turkey
- All studied prophylaxis vs non prophylaxis
- Small studies
  - N= 60; 60; 77
- No effect with regards to time to the presence of wound infection
Use of enteral nutrition

Review

Early enteral nutrition versus late enteral nutrition for burns patients: A systematic review and meta-analysis

Yi-nan Guo, Hui Li, Pi-hong Zhang*

Department of Burns & Plastic Surgery, Xiangya Hospital, Central South University, No. 87, Xiangya road, Changsha 410008, Hunan, China
### 2.1.1 Morality

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>EEN Events</th>
<th>EEN Total</th>
<th>LEN Events</th>
<th>LEN Total</th>
<th>Weight %</th>
<th>Risk Ratio M-H, Fixed, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Michael 2004</td>
<td>4</td>
<td>14</td>
<td>5</td>
<td>13</td>
<td>26.7%</td>
<td>0.74 [0.25, 2.18]</td>
</tr>
<tr>
<td>Michele 2002</td>
<td>4</td>
<td>36</td>
<td>3</td>
<td>36</td>
<td>15.4%</td>
<td>1.33 [0.32, 5.54]</td>
</tr>
<tr>
<td>Venter 2007</td>
<td>2</td>
<td>11</td>
<td>1</td>
<td>10</td>
<td>5.4%</td>
<td>1.82 [0.19, 17.12]</td>
</tr>
<tr>
<td>Vesna 2013</td>
<td>5</td>
<td>52</td>
<td>10</td>
<td>50</td>
<td>52.5%</td>
<td>0.48 [0.18, 1.31]</td>
</tr>
<tr>
<td><strong>Subtotal (95% CI)</strong></td>
<td><strong>113</strong></td>
<td><strong>109</strong></td>
<td><strong>109</strong></td>
<td></td>
<td><strong>100.0%</strong></td>
<td><strong>0.75 [0.41, 1.39]</strong></td>
</tr>
</tbody>
</table>

**Total events**: 153

Heterogeneity: Chi² = 1.98, df = 3 (P = 0.58); I² = 0%

Test for overall effect: Z = 0.90 (P = 0.37)

### 2.1.2 Sepsis

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>EEN Events</th>
<th>EEN Total</th>
<th>LEN Events</th>
<th>LEN Total</th>
<th>Weight %</th>
<th>Risk Ratio M-H, Fixed, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Michele 2002</td>
<td>17</td>
<td>36</td>
<td>21</td>
<td>36</td>
<td>77.8%</td>
<td>0.81 [0.52, 1.26]</td>
</tr>
<tr>
<td>Venter 2007</td>
<td>0</td>
<td>11</td>
<td>0</td>
<td>10</td>
<td>Not estimable</td>
<td></td>
</tr>
<tr>
<td>Vesna 2013</td>
<td>2</td>
<td>52</td>
<td>6</td>
<td>52</td>
<td>22.2%</td>
<td>0.33 [0.07, 1.56]</td>
</tr>
<tr>
<td><strong>Subtotal (95% CI)</strong></td>
<td><strong>99</strong></td>
<td><strong>98</strong></td>
<td></td>
<td></td>
<td><strong>100.0%</strong></td>
<td><strong>0.70 [0.45, 1.09]</strong></td>
</tr>
</tbody>
</table>

**Total events**: 193

Heterogeneity: Chi² = 1.27, df = 1 (P = 0.26); I² = 22%

Test for overall effect: Z = 1.57 (P = 0.12)

### 2.1.3 Wound infection

<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>EEN Events</th>
<th>EEN Total</th>
<th>LEN Events</th>
<th>LEN Total</th>
<th>Weight %</th>
<th>Risk Ratio M-H, Fixed, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Michele 2002</td>
<td>5</td>
<td>36</td>
<td>9</td>
<td>36</td>
<td>68.8%</td>
<td>0.56 [0.21, 1.50]</td>
</tr>
<tr>
<td>Vesna 2013</td>
<td>3</td>
<td>52</td>
<td>4</td>
<td>50</td>
<td>31.2%</td>
<td>0.72 [0.17, 3.06]</td>
</tr>
<tr>
<td><strong>Subtotal (95% CI)</strong></td>
<td><strong>88</strong></td>
<td><strong>86</strong></td>
<td></td>
<td></td>
<td><strong>100.0%</strong></td>
<td><strong>0.61 [0.27, 1.37]</strong></td>
</tr>
</tbody>
</table>

**Total events**: 88

Heterogeneity: Chi² = 0.09, df = 1 (P = 0.77); I² = 0%

Test for overall effect: Z = 1.20 (P = 0.23)
Conclusions

• Burns and infections are closely linked
• Burns > 40% will often develop severe infection(s)
• Multiresistant bacteria are increasingly found
  • In particular Acinetobacter Baumanii species
• Culture surveillance can give an advantage
• Know your “home-bugs”
• Prophylactic AB probably does not give a positive result
• Early EN is probably better than late in order to prevent infections